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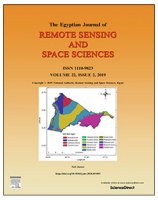

Implementation of a topographic artificial neural network wind speed prediction model for assessing onshore wind power potential in Sibu, Sarawak

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ABSTRACT

This study presents a topographic machine learning based wind speed prediction model. Predicted and ground station data were used to examine the wind energy potential in Sibu. A terrain-based artificial neural network was developed using MATLAB/Simulink (2016). It was found that the developed model can predict wind speed values in areas where the model was implemented. The detailed wind resource assessment shows that the power and energy densities fall within Class 1, which is suitable for small-scale applications. The annual energy output of the selected wind turbines was found to be 2343.12–12036.85 kWh/year with an annual capacity factor in the range of 2.16%–7.77%.

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1. Introduction

Sustainable energy is the most important area that needs more attention for a nation to develop its economic potentials. Malaysia as a developing nation is experiencing an exponential rise in Gross Domestic Product (GDP) and steady GDP growth of 4.7% in 2019 and is expected to grow to 8% in 2022. For full-year 2018, the Malaysian economy grew 4.7% on-year, with a GDP value of RM1.23 trillion at constant prices and RM1.43 trillion at current prices. While the central bank has described the growth as "commendable", given the existing macroeconomic conditions, it was notably lower than the 5.9% growth in 2017 (Kani et al., 2012).

With rapid development in the economy, the country's energy consumption is growing rapidly, Malaysia's Electricity Consumption data was reported at 12,660.700 kWh in April 2019. This record an increase from the previous number of 11,794.500 kWh for March 2019. Malaysia's Electricity Consumption data is updated monthly, averaging 6455.605 kWh from Jan 1989 to Apr 2019, with 364 observations (Kani et al., 2012).

In general, clean energy has emerged as a new way to solve the problems associated with power generation using fossil fuels. In Malaysia, green energy is gaining more attention simply because, the government has formulated a sustainable policy in the 8th t Malaysia plan to boost power generation of the country by 5% (600 MW) via renewable energy sources. However, with this development, the country has recorded a low achievement, with only 1% achieved in 2005 within one decade. The conception is further reviewed in the 9th Malaysia Plan (2006–2010) which has also set a goal of 5% RE in the country's energy mix. Among the sources of RE, the wind energy was the fastest growing energy technology in terms of percentage of yearly growth of installed capacity per technology source (Ummels et al., 2009; Chooi Tan et al., 2017; Jashnani et al., 2013; Lawan et al., 2013).

Wind power is a well-recognised renewable energy producing, clean, safe, and foreseeable electric power. It has negligible carbon emission, has reduced operational and maintenance costs, compared to fossil fuels power plants, such as coal, gas and petroleum and can be operated during the day and night with virtually zero greenhouse gas emissions. Wind power has reached another scale of development in 2016. In fact, 2016 was a historical year for the global wind industry. According to the statistics conducted by the global wind energy council (GWEC) (Kani et al., 2012), global annual and cumulative installed wind power were 56,600 MW and 486,749 MW, respectively.

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